In search of **salt**

Managing Salinity in the Lower Colorado River Region

The irrigated farms of America's Southwest are known for producing bountiful fruits, vegetables, tree nuts, alfalfa, and even turfgrass. They've also become famous for their salt.

Excess salt—affecting about 30 percent of U.S. irrigated land—reduces water and nutrient uptake by plants and crops. The buildup of salts, pesticides, and other trace constituents, such as boron, also threatens water resources.

In response to the growing salinity problems of the thirsty states in the lower Colorado River region, a partnership was created 4 years ago between the Agricultural Research Service's George E. Brown, Jr., Salinity Laboratory, in Riverside, California, and the U.S. Bureau of Reclamation (USBR). This collaboration, known as the Lower Colorado Region Salinity Assessment Network (LCRSAN), has helped advance the agencies' shared goals: to monitor, control, and curb soil salinization in the area.

These roughly 1.25 million acres of agricultural lands in Arizona, southern Nevada, and southern California rely heavily on irrigation. From an aerial perspective, one can clearly see the patchwork of green and brown squares that denote the water-fed boundaries of the region. Water channeled from the Colorado River and its tributaries and ultimately guided onto farmers' fields allows familiar crops, like lettuce, onions, and table grapes, to flourish almost year round.

But as the water runs its course across the landscape, it dissolves soluble salts contained in rocky river beds, corridors, and canyons. These salts continuously bombard agricultural soils, stressing plants and reducing crop yields. Salts accumulate in the soil as plants take up water through transpiration. The situation is further aggravated by the region's dry heat, causing irrigation waters to evaporate even more rapidly.

Where's the Salt?

The first of its kind in the United States, the LCRSAN project hopes to pinpoint problems associated with salt-affected lands by converging cutting-edge technology, resources, and individuals. Through the program, USBR has brought ARS-developed hardware and software to several salinity-action agencies that, in turn, assist their local farmers and growers.

STEPHEN AUSMUS (K11338-20)

ARS cooperative statistician Scott Lesch performs a precalibration check on a conductivity meter before beginning an orchard survey.

The participating agencies include: the Coachella Valley Resource Conservation District and the Imperial Irrigation District—both of California; Yuma Agricultural Center, Yuma, Arizona; and the U.S. Bureau of Indian Affairs, along with the Natural Resources Conservation Service office in Parker, Arizona.

"Many growers in these areas have only had very basic soil tests to diagnose complicated salinity issues. Others draw conclusions about the state of their soils simply through visual surveys," says University of California statistician Scott M. Lesch. Located at the Riverside laboratory, Lesch assists ARS as the LCRSAN technical program coordinator.

With USBR funding, each area received salinity-assessment field equipment that was developed at the salinity laboratory. The mobile rig, better known as the "Salt Sniffer," uses a new electromagnetic inductance meter that seeks out salt in the soil. The meter relays conductivity survey data to a real-time GPS receiver. The survey and location data are stored in a GPS data logger, which can then be downloaded and used to produce maps of a field's soil patterns.

Lesch and colleagues provided training on the remote-sensing soil-assessment equipment and continue to offer day-to-day advice on the various aspects of soil surveying. Lesch also trains field specialists on using the software, which interprets data gathered in the field.

Together, the equipment and software can inform growers about a range of soil conditions, including salinity levels, salt-loading characteristics, and soil texture. A useful product of the software is a sampling plan that can direct a farmer to parts of a field that are showing some sort of variability. Soil samples can then be taken to determine precisely what's causing the irregularity.

The software package is called "ESAP." The current version, 2.30, can be downloaded free of charge from the Salinity Laboratory's web site at www.ussl.ars.usda.gov. (Click on "Models.") Lesch says there are now about 200 registered users of the software across North America and Australia.

Powerful Potential

An ideal use of the LCRSAN program's equipment and software, says ARS soil scientist Dennis L. Corwin, is to assess the practice of using recycled drainage waters to irrigate fields. Making use of these waters, which are generally considered low quality and hard to dispose of, could greatly conserve fresh water sources, reduce drainage water disposal problems, and enhance on-farm efficiency.

SCOTT LESCH (K11191-1)

A dual purpose rig, this typical "Salt Sniffer" surveying platform uses a conductivity meter carried in the tail sled and a Giddings drilling rig attached to the front, facilitating both soil surveying and soil sampling.

But many farmers may be leery of using recycled waters for fear of damaging their crops. "With the equipment, you can monitor small changes in the soil over time," Corwin says. "You can see whether applying recycled waters is a sustainable practice and find out to what extent the water can be safely and effectively used."

Another application of the field equipment and associated software is a newer practice known as precision leaching. "If a farmer believes his land is suffering from saline conditions, he'll often reclaim the land by applying additional waters, to leach out the excess salt," says Lesch. "But, in many cases, the farmer may unnecessarily leach an entire field to remedy just one area that's experiencing high salinity. The ARS equipment can be used to find and treat just the problem spots, which would conserve water."

The Next Step

Most members of the LCRSAN network are up and running—capable of producing informative soil-salinity maps and profiles. The Imperial Valley, a productive agricultural center in southern California, recently completed its 100th salinity survey.

"While there is a growing awareness of the problem of salinity in the region, we still don't know how extensive it really is. There's no current inventory of saline conditions throughout the country," says Corwin.

The concept of developing mobilized equipment that can assess salinity across vast areas started with James D. Rhoades, former director of the Riverside laboratory. His successors hope that these technologies can be used to their full potential throughout the United States and worldwide. They'd also like to someday pool the incoming salinity data from several local districts to assess salinity on a broader scale.

In the meantime, the salinity lab is continuing to develop resources to ease the task of identifying and improving saline soils.

"We're developing decision-support software that would supplement existing software," says current lab director Donald L. Suarez. "It would make specific recommendations to farmers and growers trying to make management decisions based on data from soil surveys."—By **Erin Peabody,** ARS.

This research is part of Water Quality and Management (#201) and Soil Resource Management (#202), two ARS National Programs described on the World Wide Web at www.nps.ars.usda.gov.

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Aerial view of fields in central California (western San Joaquin Valley) suffering from severe salinization.